AD-A106 435 BLACK AND VEATCH KANSAS CITY MO F/G 13/13
NATIONAL DAM SAFETY PROGRAM. ROCK ISLAND LAKE DAM (MO 20182), M--ETC(U)
AUG 79 P R ZAMAN, E R BURTON, H L CALLAHAN DACW43-79-C-0040

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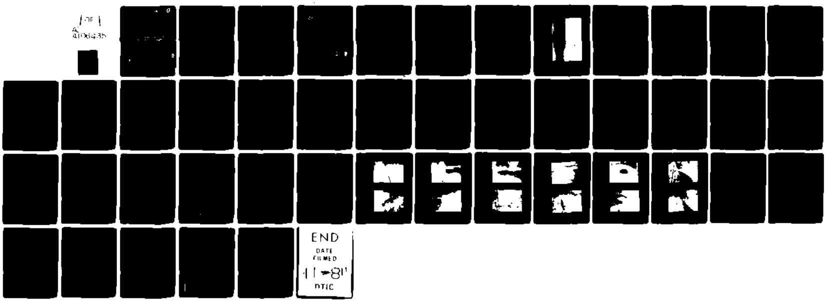

LEVEL II

MISSOURI-KANSAS CITY BASIN

AD A106435

ROCK ISLAND LAKE DAM

JOHNSON COUNTY, MISSOURI

MO 20182

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY ~~INSPECTION~~ Program

United States Army
Corps of Engineers
...Serving the Army
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St. Louis District

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PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

AUGUST 1979

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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MISSOURI-KANSAS CITY BASIN

ROCK ISLAND LAKE DAM

JOHNSON COUNTY, MISSOURI

MO 20182

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION

United States Army
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St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

AUGUST 1979

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Rock Island Lake Dam Mo. ID No. 20182
Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Rock Island Lake Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

SUBMITTED BY:	SIGNED Chief, Engineering Division	26 MAR 1980 Date
APPROVED BY:	SIGNED Colonel, CE, District Engineer	26 MAR 1980 Date

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ROCK ISLAND LAKE DAM

JOHNSON COUNTY, MISSOURI

MISSOURI INVENTORY NO. 20182

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

BLACK & VEATCH
CONSULTING ENGINEERS
KANSAS CITY, MISSOURI

UNDER DIRECTION OF

ST. LOUIS DISTRICT CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

AUGUST 1979

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Rock Island Lake Dam
State Located	Missouri
County Located	Johnson County
Stream	Scaly Bark Creek
Date of Inspection	7 August 1979

Rock Island Lake Dam was inspected by a team of engineers from Black & Veatch, Consulting Engineers for the St. Louis District, Corps of Engineers. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and state agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. According to the St. Louis District, Corps of Engineers, failure would threaten the life and property of approximately four families and six buildings within the estimated damage zone which extends approximately three miles downstream of the dam.

Our inspection and evaluation indicates the spillway does meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillway design flood recommended by the guidelines is 50 to 100 percent of the probable maximum flood. The spillway will not pass the probable maximum flood without overtopping but will pass 55 percent of the probable maximum flood. The spillway will pass the 100-year flood. Considering the small volume of water impounded by the dam and the downstream hazard, 50 percent of the probable maximum flood is the appropriate spillway design flood. The probable maximum flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Deficiencies visually observed by the inspection team were undermining of the spillway, cracks in the spillway walls, the presence of excessive brush and trees on the embankment slopes, animal burrows in the embankment slopes, erosion on the embankment slopes, and the displacement of the ballast material along the crest of the embankment. Seepage and stability analyses required by the guidelines were not available.

There were no observed deficiencies or conditions existing at the time of the inspection which indicated an immediate safety hazard. Future corrective action and regular maintenance will be required to correct or control the described deficiencies. In addition, detailed seepage and stability analyses of the existing dam, as required by the guidelines, should be performed. A detailed report discussing each of these deficiencies is attached.

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Harry L. Callahan
Harry L. Callahan, Partner
Black & Veatch

OVERVIEW OF LAKE

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
ROCK ISLAND LAKE DAM

TABLE OF CONTENTS

LIST OF PLATES

LIST OF PHOTOGRAPHS

APPENDIX

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the District Engineer of the St. Louis District, Corps of Engineers, directed that a safety inspection of the Rock Island Lake Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is an earth structure located in the valley of Scaly Bark Creek in southwestern Johnson County, Missouri (Plate 1). The dam is a railroad embankment consisting of an earth fill with a maximum height of approximately 25 feet. The dam has a top width of 14 feet and the slopes are covered with vegetation. It is approximately 2,700 feet long with an upstream slope of approximately 1.0 vertical on 2.7 horizontal and a downstream slope of approximately 1.0 vertical on 2.4 horizontal. Topography in the vicinity of the dam is shown on Plate 2.

(2) The spillway is located at the right edge of the lake and is a drop inlet structure. After entering the drop inlet, water flows through the embankment by way of a 7 foot by 12 foot concrete arch culvert. The flow then exits into the natural earth channel of Scaly Bark Creek.

(3) Pertinent physical data are given in paragraph 1.3.

b. Location. The dam is located in southwestern Johnson County, Missouri, as indicated on Plate 1. The lake formed by the dam is shown on the United States Geological Survey 7.5 minute series quadrangle map for Kingsville, Missouri in Section 33 of T45N, R28W.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, the dam and impoundment are in the small size category.

d. Hazard Classification. The hazard classification assigned by the Corps of Engineers for this dam is as follows: The Rock Island Lake Dam has a high hazard potential, meaning that the dam is located where failure may cause loss of life, and serious damage to homes, agricultural, industrial and commercial facilities, and to important public utilities, main highways, or railroads. For the Rock Island Lake Dam the estimated flood damage zone extends downstream for approximately three miles. Within the damage zone are four homes and six buildings.

e. Ownership. The dam is owned by the Chicago, Rock Island, and Pacific Railroad Company, 518 South 17th Street, Kansas City, Kansas 66105.

f. Purpose of Dam. The dam forms a 32-acre recreational lake.

g. Design and Construction History. Design history was not available. The dam was originally built in 1905 as a railroad water supply for steam locomotives. The railroad presently owns a 50 foot right of way including the dam which is the railroad embankment. The lake is owned by the Medford Hunting and Fishing Club.

h. Normal Operating Procedure. Normal rainfall, runoff, transpiration, evaporation, and outflow over the spillway all combine to maintain a relatively stable water surface elevation.

1.3 PERTINENT DATA

a. Drainage Area - 336 acres

b. Discharge at Damsite.

(1) Normal discharge at the damsite is through an uncontrolled spillway.

(2) Estimated experienced maximum flood at damsite - Unknown.

(3) Estimated ungated spillway capacity at maximum pool elevation is 1,019 cfs (top of Dam El.870.1).

c. Elevation (Feet above m.s.l.).

(1) Top of dam - 870.1 ± (see Plate 3)

(2) Spillway crest - 866.0

(3) Streambed at toe of dam - 845.0 ±

(4) Maximum tailwater - Unknown.

d. Reservoir.

(1) Length of maximum pool - 2,400 feet ±

(2) Length of normal pool - 2,200 feet ±

e. Storage (Acre-feet).

(1) Top of dam - 357 (estimated)

(2) Spillway crest - 160 (estimated)

(3) Design surcharge - Not available.

f. Reservoir Surface (Acres).

(1) Top of dam - 62

(2) Spillway crest - 32

g. Dam.

(1) Type - Earth embankment

(2) Length - 2,700 feet

(3) Height - 25 feet ±

(4) Top width - 14 feet

(5) Side slopes - upstream face 1.0 V on 2.7 H, downstream face 1.0 V on 2.4 H (see Plate 4).

(6) Zoning - Unknown.

(7) Impervious core - Unknown.

(8) Cutoff - Unknown.

(9) Grout curtain - Unknown.

h. Diversion and Regulating Tunnel - None.

i. Spillway.

(1) Type - Drop inlet.

(2) Length of crest - 46 feet (see Plate 5).

(3) Crest elevation - 866.0 feet m.s.l.

(4) Gates - None.

(5) Upstream channel - Earth and vegetation with no defined channel.

(6) Downstream channel - 7 foot by 12 foot concrete arch culvert through the embankment then to the natural earth channel.

j. Regulating Outlets - None.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Design data were unavailable.

2.2 CONSTRUCTION

Construction records were unavailable, however, the superintendent of the Chicago, Rock Island, and Pacific Railroad Company, Don Garber (Phone Number 342-2952), said that the dam was built in 1905. The lake was originally built by the railroad to provide water supply for steam locomotives and was later sold to the Medford Hunting and Fishing Club, the present owners.

2.3 OPERATION

Procedural criteria for operation of this dam were not available. Documentation of past experiences of a serious nature was also not available.

2.4 GEOLOGY

The dam is located in a very broad, shallow valley developed in Pennsylvanian age limestone, shale, and occasional thin coal beds of the Desmoinesian Series Marmaton Group. It is anticipated that the floor, sides and valley ridges all consist of cyclic shale and limestone beds of the Fort Scott and lower Appanoose Subgroups. The residual Deepwater, Haig, and Sampsel soil series completely cover the entire watershed so no bedrock units are visible in the area.

It is anticipated that the foundation and abutments for the dam consists of Pennsylvanian age shale with some limestone. It is not known whether the soil cover was removed or if a cut-off trench was constructed beneath the dam. The soils present on the valley floor and sides (Deepwater and Sampsel Series) consist of residual silty clays developed above shale bedrock, while those on the ridges consist of residual silty clays developed on upland loess deposits. Deepwater soils have a silt loam surface layer 18 inches thick, underlain by a silty clay loam subsoil that extends to 62 inches. Sampsel soils have a 12 inch thick silty clay loam surface layer overlying silty clay loam that grades into a silty clay that extends to 66 inches where it is underlain by a soft, silty clay bedrock. Haig soils consist of silt loam and silty clay loam surface layers that grade into silty clay loam and silty clay below 15 inches. For engineering purposes, the near surface soils can be classified as clayey silt (ML) and/or silty clay (CL), and the deeper soils as medium to high plasticity silty clay (CL or CH).

2.5 EVALUATION

a. Availability. No engineering data could be obtained.

b. Adequacy. No engineering data were available upon which to make a detailed assessment of the design, construction, and operation. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity. The validity of the design, construction, and operation could not be determined due to the lack of engineering data.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of Rock Island Lake Dam was made on 7 August 1979. The inspection team included professional engineers with experience in dam design and construction, hydrology, hydraulic engineering, and geotechnical engineering. No representative of the Chicago, Rock Island, and Pacific Railroad Company was present on the day of inspection. This dam appeared to be in satisfactory condition. Specific observations are discussed below. No observations were made of the condition of the upstream face of the dam below the pool elevation at the time of the inspection.

b. Dam. The inspection team observed the following items at the dam. The ballast material which covers the top of the dam is displaced in some areas. Some bulging of this rock material adjacent to the tracks was also sighted making the edge of the crest irregular. It is believed that the smooth rounded river rock with a low angle of repose used as ballast material is probably the cause of this movement. There were a few locations along the top of the embankment where new ballast material had been placed to repair the roadbed. Growth of brush and trees was heavy on the upstream and downstream slopes of the embankment with a couple of trees as large as approximately 12 inches in diameter. A few small animal burrows were found in the embankment slopes. There was some minor erosion of the upstream slope evident above the riprap in a few locations. The lake level at the time of the inspection was approximately 0.6 feet below normal pool elevation. No cracking, sliding, or sinkholes were observed on the embankments. Also no sloughing or seepage was observed on the downstream embankment.

c. Appurtenant Structures. The inspection team observed the following items pertaining to appurtenant structures. The concrete drop inlet spillway appeared in fair condition. The spillway is acting as a broad-crested weir. The walls of the drop inlet contain vertical cracks; some of these cracks have been repaired with mortar. The 7 foot by 12 foot concrete arch culvert also appears in fair condition. A circumambient crack appears in the arch from flowline or floor on the right side across the top to the floor of left side about six feet from the upstream end; another crack appears two feet from the downstream outlet. Also there is a crack along the crown parallel to the centerline, evident for the length of the culvert. The floor of the concrete arch is undermined for approximately the full length from the upstream to the downstream end. The floor is cracked and the concrete is displaced 6 to 8 inches near the downstream end. Erosion on the downstream slope, adjacent to the outlet structure, was noted. This erosion possibly has caused the excessive steep slope of the embankment near the outlet structure.

d. Reservoir Area. Topography of the contributing watershed is characterized by gently rolling hills which should allow even runoff during periods of precipitation. The vegetation of the watershed is primarily composed of grassland and timber. No slides or excessive erosion due to wave action were observed along the shore of the reservoir. A significant amount of siltation appears to have occurred in the reservoir. Approximately half of the surface area of the lake was covered by aquatic plants in water only 2 to 3 feet deep.

e. Downstream Channel. Heavy vegetation along the banks and mild channel slopes typical of streams in the area characterize the downstream channel.

f. Geology. Vegetative and soil cover completely obscured all bedrock units at the site. No unusual geologic conditions were observed.

3.2 EVALUATION

The various minor deficiencies observed at the time of the inspection are not believed to represent any immediate safety hazard. They do, however, warrant repair and future monitoring and control.

(1) Tree and brush growth on the embankment slopes should be controlled. Consideration should be made for the removal of large trees and their root systems under the guidance of an engineer experienced in the design and construction of earthen dams. If large water seeking roots should someday rot and decay, then these roots could become channels for piping. Also large brush growth on the embankments prevents inspection of the slope and kills the smaller grasses whose roots are more effective in protecting the surface soil.

(2) Further animal burrowing in the embankment should be prevented and the holes should be filled in with properly compacted material. Burrowing animals (muskrats and ground squirrels) have been responsible for piping failures in a number of small earth dams. If willows or other brush grow at the water line, muskrats will dig under them because the roots reinforce the opening of the hole and also hide its existence.

(3) The erosion on the embankment slopes should be repaired and proper slope protection reestablished so that further loss of embankment material is prevented.

(4) Undermining of the spillway arch culvert and the cracks in the culvert walls should be repaired so that further deterioration is prevented.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The pool is primarily controlled by rainfall, runoff, evaporation, transpiration, and capacity of the uncontrolled spillway.

4.2 MAINTENANCE OF DAM

Maintenance performed was unknown. It was observed that ballast has been added to the embankment at several locations along the crest. There is no evidence of mowing or brush and tree control at the damsite.

4.3 MAINTENANCE OF OPERATING FACILITIES

There are no operating facilities known to exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no existing warning system for this dam.

4.5 EVALUATION

A maintenance program should be established to control the growth of brush and trees on the embankment. The undermining of the spillway arch culvert and the cracks in the spillway walls should be repaired. Existing animal burrows in the embankment and erosion on the embankment slopes warrant repair. These items noted increase the potential for failure and warrant repair and regular monitoring.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Design data pertaining to hydrology and hydraulics were unavailable.

b. Experience Data. The drainage area and lake surface area are developed from USGS Kingsville Quadrangle Map. The spillway and dam layouts are from surveys made during the inspection.

c. Visual Observations.

(1) The spillway is in fair condition with no evidence of significant erosion. The approach area has heavy vegetation growth.

(2) There are no construction features incorporated in the dam for evacuating the pool. Evacuation could be accomplished only by lowering the channel of the spillway or by pumping.

(3) Spillway releases would not endanger the integrity of the dam.

d. Overtopping Potential. The spillway will not pass the probable maximum flood without overtopping the dam. The probable maximum flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The spillway will pass 55 percent of the probable maximum flood without overtopping the dam. The spillway will pass the 100-year outflow estimated to be 280 cfs developed by a 24-hour, 100-year frequency rainfall. According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, a high hazard dam of small size should pass 50 to 100 percent of the probable maximum flood. Considering the small volume of water impounded by the dam and the downstream hazard, the appropriate spillway design flood should be 50 percent of the probable maximum flood. The portion of the estimated peak discharge of the probable maximum flood overtopping the dam would be 1,470 cfs of the total discharge from the reservoir of 2,560 cfs. The estimated duration of overtopping is 3.2 hours with a maximum height of 1.0 foot. Failure of upstream water impoundment shown on the 1954 USGS map would not have a significant impact on the hydrologic or hydraulic analysis. Although evidence of overtopping of the embankment was not visible, soils typical of the embankment surfaces are susceptible to erosion. Should the embankment be subjected to prolonged overtopping it is believed that the subsequent erosion could lead to failure.

According to the St. Louis District, Corps of Engineers, the effects from rupture of the dam could extend approximately three miles downstream

of the dam. There are four homes and six buildings which could be severely damaged and lives could be lost should failure of the dam occur.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of conditions which affect the structural stability of this dam are discussed in Section 3, paragraph 3.1b.

b. Design and Construction Data. No design data relating to the structural stability of the dam were found. Detailed seepage and stability analyses as required by the guidelines are not available, which is considered a deficiency.

c. Operating Records. No operational records exist.

d. Post Construction Changes. There is evidence to indicate that movement of the ballast material has taken place in the past. New ballast material has been added at various locations along the crest of the embankment. No design data relating to the addition of the ballast material to the embankment were found.

e. Seismic Stability. The dam is located in Seismic Zone 1 which is a zone of minor seismic risk. A properly designed and constructed earth dam using sound engineering principles and conservatism should pose no serious stability problems during earthquakes in this zone.

The seismic stability of an earth dam is dependent upon a number of factors: The important factors being embankment and foundation material classification and shear strengths; abutment materials, conditions, and strength; embankment zoning; and embankment geometry. Adequate descriptions of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment were not available and therefore no inferences will be made regarding the seismic stability. An assessment of the seismic stability should be included as part of the stability analysis required by the guidelines.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. Several items were noted during the visual inspection. The undermining of the arch culvert, the cracks in the spillway walls, an uncontrolled stand of brush and trees on the embankment slopes, animal burrows in the embankment slopes, erosion on the embankment slopes, and the displacement of the ballast material along the crest of the embankment should all be monitored or controlled. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

b. Adequacy of Information. Due to the lack of engineering design data, the conclusions in this report were based only on performance history and visual conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. It is the opinion of the inspection team that a program should be developed to implement remedial measures recommended in paragraph 7.2b.

d. Necessity for Phase II. The Phase I investigation does not raise any serious questions relating to the safety of the dam or identify any serious dangers that would require a Phase II investigation.

e. Seismic Stability. This dam is located in Seismic Zone 1. Adequate description of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment were not available and therefore no inferences will be made regarding the seismic stability. An assessment of the seismic stability should be included as part of the recommended stability analysis.

7.2 REMEDIAL MEASURES

a. Alternatives. No measures are recommended.

b. Operation and Maintenance Procedures. The following operation and maintenance procedures should be implemented to correct the deficiencies observed at the time of inspection. If left unattended or unrepaired each could ultimately become a potential source of failure.

(1) The spillway arch culvert should be repaired and protected from undermining. The cracks in the spillway walls should also be repaired.

(2) A regular maintenance program should be implemented to control growth on the downstream and upstream slopes of the dam. An engineer experienced in the maintenance and design of dams should be retained to recommend procedures for the removal of trees and their root systems, along with the reestablishment of proper slope protection.

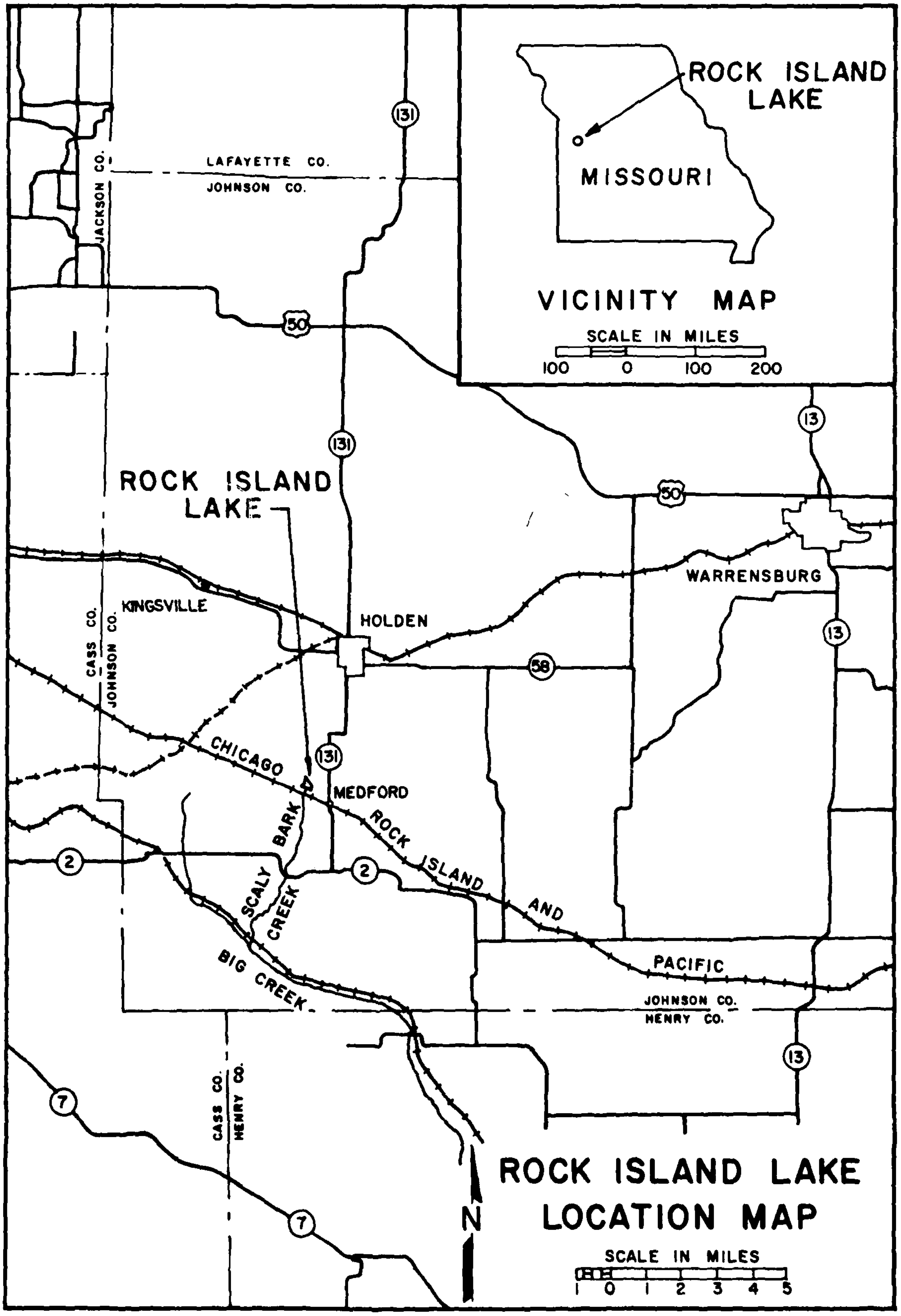
(3) The erosion on the embankment slopes should be repaired and proper slope protection restored.

(4) The control and prevention of rodent activity should be considered. Animal burrows could lead to a piping failure. The holes should be filled and compacted to the original specification.

(5) Check the downstream face of the dam periodically for seepage and stability problems. If seepage flows are observed or sloughing on the embankment slope is noted, the dam should immediately be inspected and the condition evaluated by an engineer experienced in design and construction of earthen dams.

(6) To satisfy the guideline requirements seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of dams. It should be noted that the embankment slopes are rather steep when compared to current design practices and could lead to a stability problem.

(7) A detailed inspection of the dam should be made periodically by an engineer experienced in design and construction of dams. More frequent inspections may be required if additional deficiencies are observed or the severity of the reported deficiencies increases.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MISSOURI
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LAFAYETTE CO.
JOHNSON CO.
JACKSON CO.
131
50
13
ROCK ISLAND LAKE
WARRENSBURG
KINGSVILLE
HOLDEN
CASS CO.
JOHNSON CO.
58
CHICAGO ROCK ISLAND AND PACIFIC
MEDFORD
BARK
SCALY CREEK
2
BIG CREEK
JOHNSON CO.
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CASS CO.
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ROCK ISLAND LAKE
LOCATION MAP
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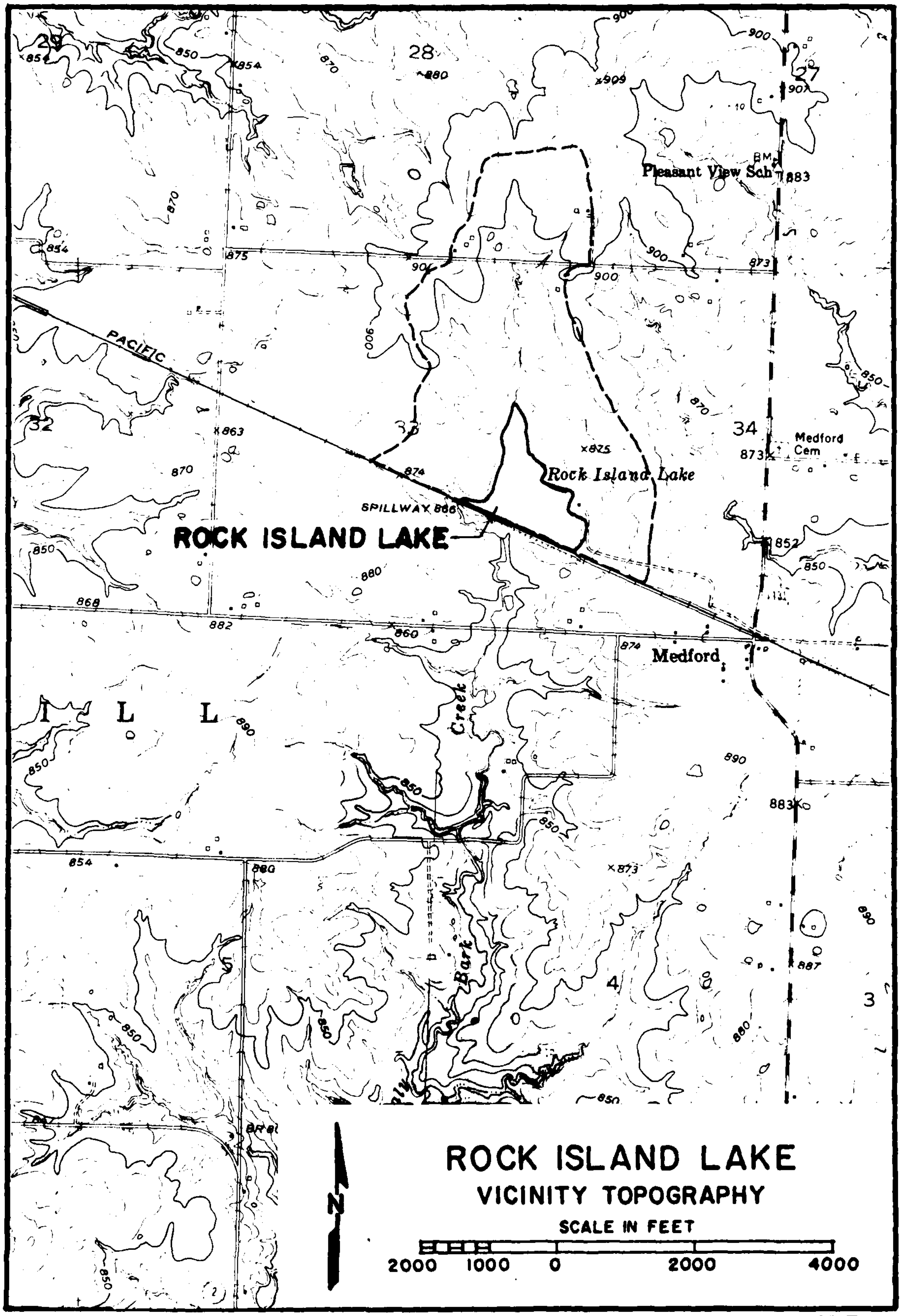
PLATE I



ROCK ISLAND LAKE
Rock Island Lake
SPILLWAY 866
PACIFIC
Pleasant View Sch
Medford
Medford Cem
Creek
Bark
28
27
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ROCK ISLAND LAKE
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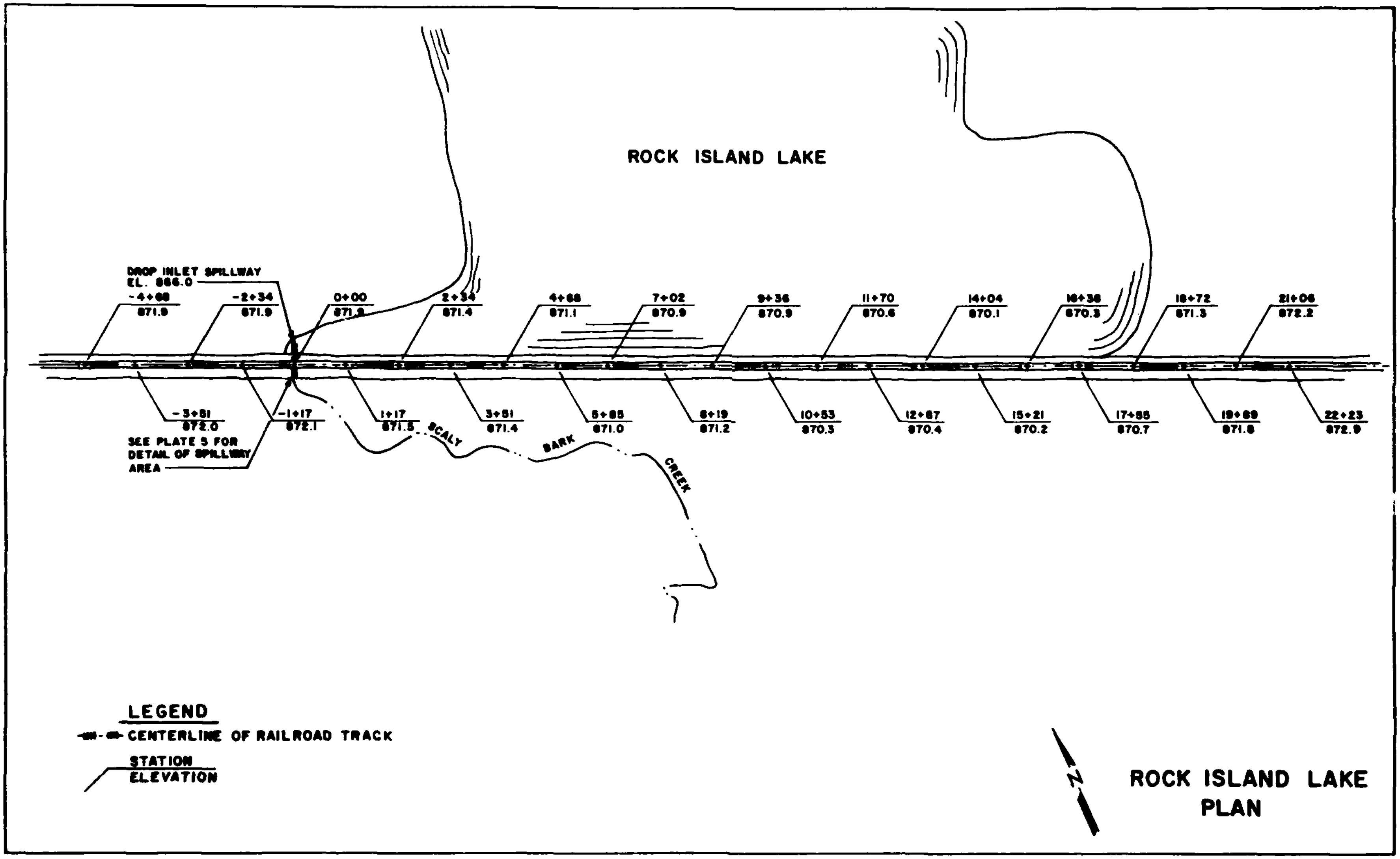
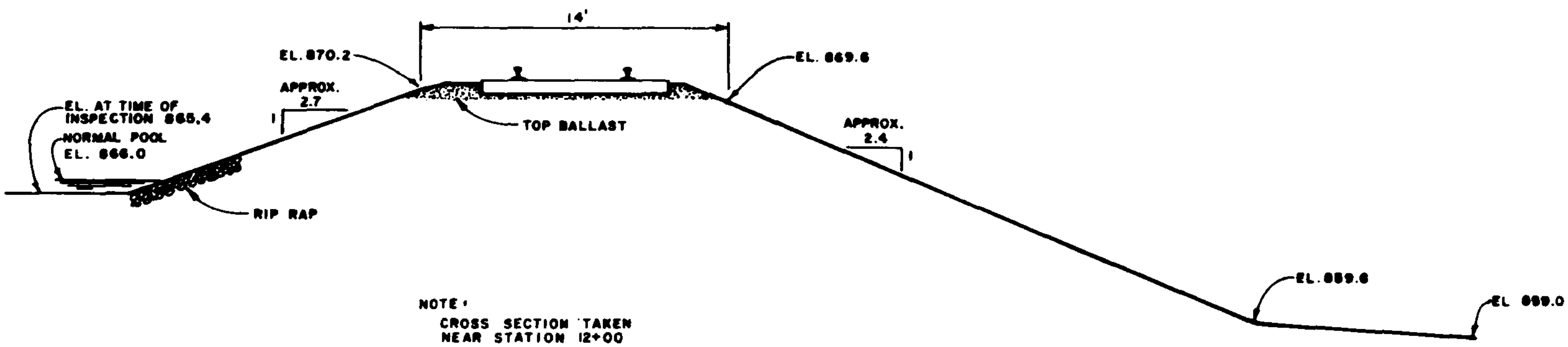
PLATE 2



ROCK ISLAND LAKE
PLAN

PLATE 3



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ROCK ISLAND LAKE
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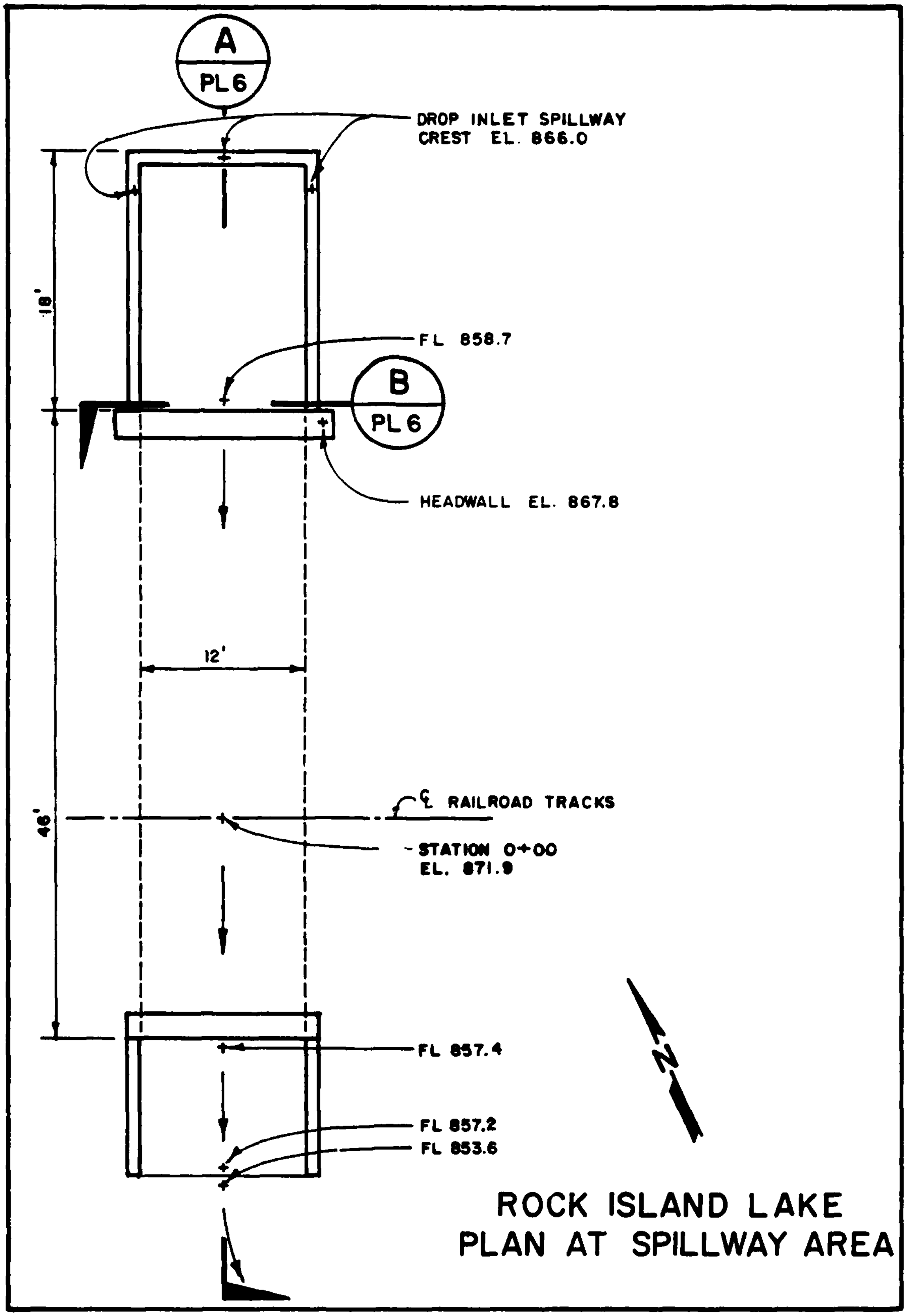
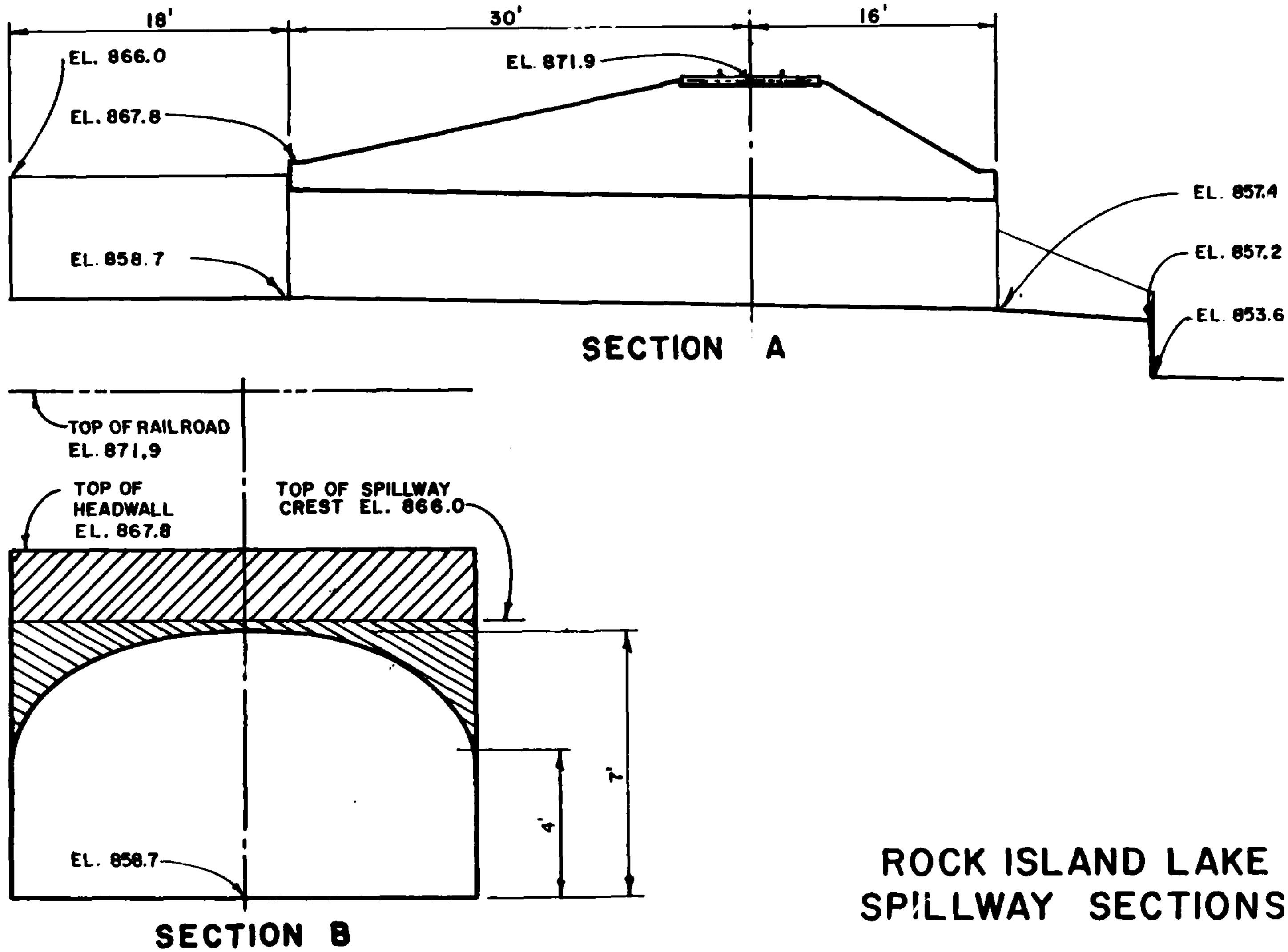
PLATE 4

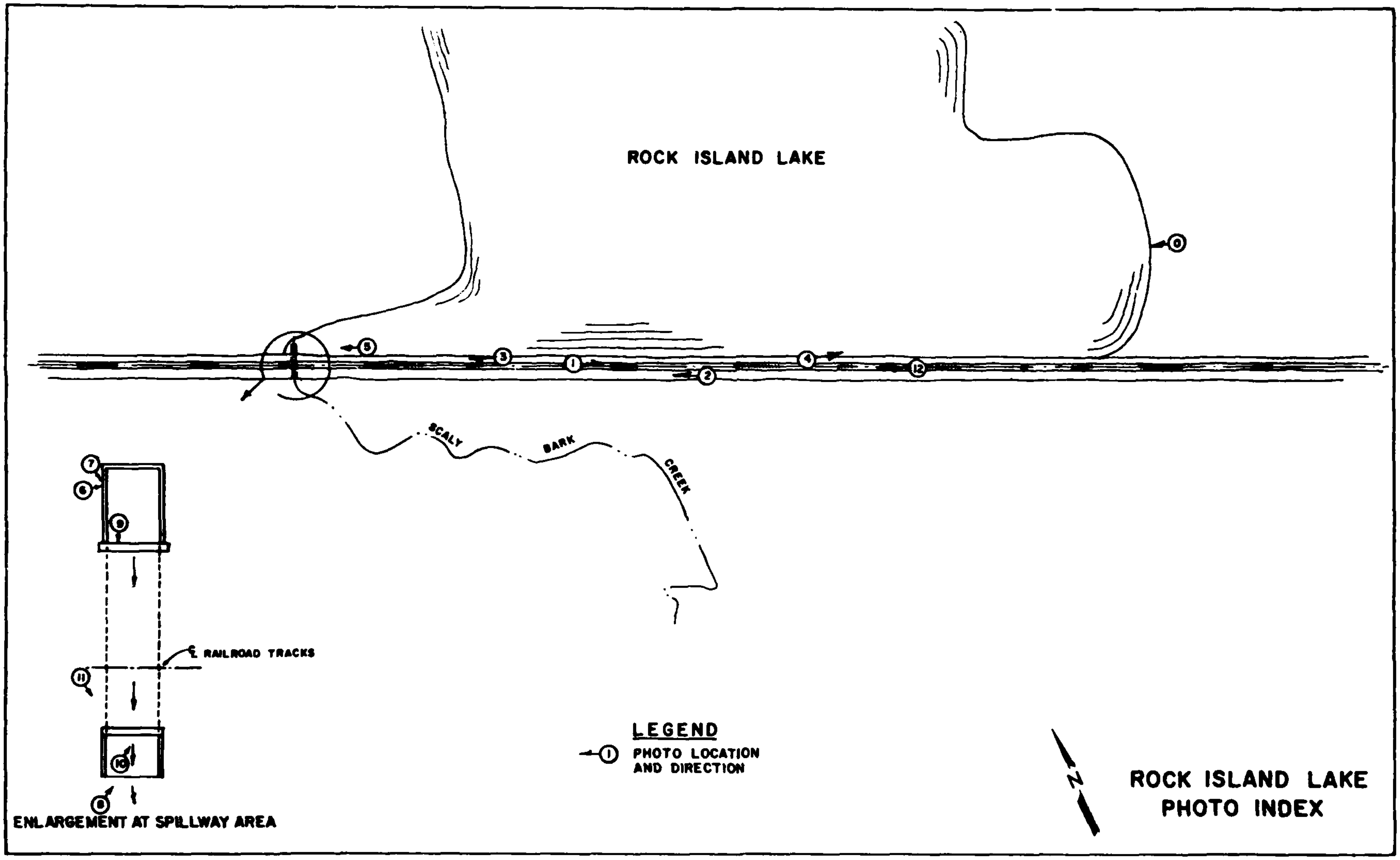


ROCK ISLAND LAKE
PLAN AT SPILLWAY AREA



ROCK ISLAND LAKE
SPILLWAY SECTIONS

PLATE 6



ROCK ISLAND LAKE
PHOTO INDEX

PLATE 7

PHOTO 1: CREST OF DAM

PHOTO 2: DOWNSTREAM SLOPE OF DAM

PHOTO 3: UPSTREAM FACE OF DAM

PHOTO 4: UPSTREAM SLOPE PROTECTION

PHOTO 5: SPILLWAY APPROACH

PHOTO 6: SPILLWAY VIEWED FROM DOWNSTREAM [illegible] D

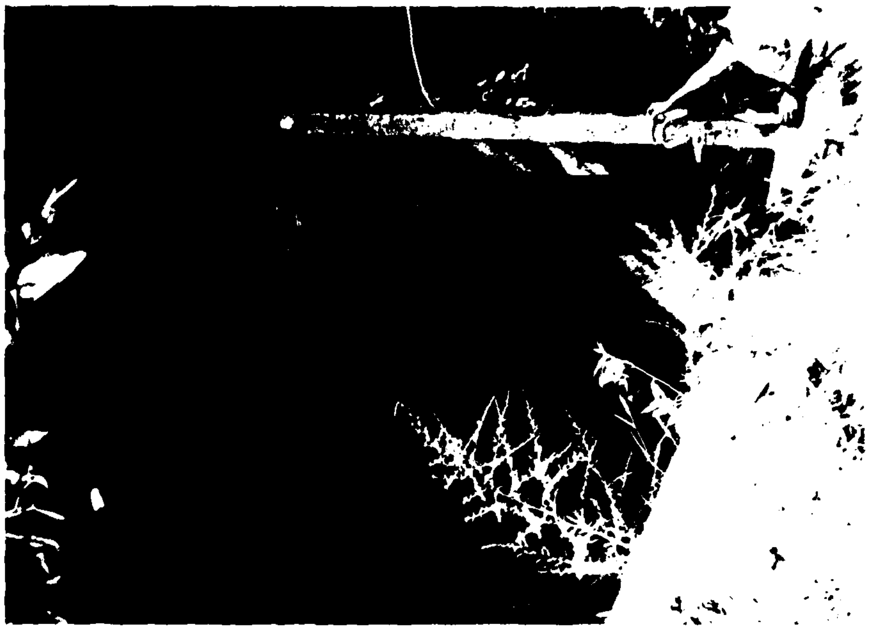


PHOTO 7: UPSTREAM END OF SPILLWAY CULVERT

PHOTO 8: DOWNSTREAM END OF SPILLWAY CULVERT

PHOTO 9: SPILLWAY CULVERT LOOKING DOWNSTREAM

PHOTO 10: UNDERCUTTING OF SPILLWAY CULVERT SLAB

PHOTO 11: EMBANKMENT EROSION OF DOWNSTREAM FACE AT SPILLWAY

PHOTO 12: AREA OF [illegible]

APPENDIX A

HYDROLOGIC COMPUTATIONS

HYDROLOGIC COMPUTATIONS

1. The Soil Conservation Service (SCS) dimensionless unit hydrograph (1) and HEC-1 (2) were used to develop the inflow hydrographs and hydrologic inputs as follows:

a. Twenty-four hour, probable maximum precipitation determined from U.S. Weather Bureau Hydrometeorological Report No. 33.

200 square mile, 24 hour rainfall inches	- 25.0
10 square mile, 6 hour percent of 24 hour 200 square mile rainfall	- 101%
10 square mile, 12 hour percent of 24 hour 200 square mile rainfall	- 120%
10 square mile, 24 hour percent of 24 hour 200 square mile rainfall	- 130%

b. Drainage area = 336 acres.

c. Time of concentration: $Tc = (11.9 \times L^3/H)^{0.385} = 0.51$ hours = 31 minutes (L = length of longest watercourse in miles, H = elevation difference in feet) (3)

d. Losses were determined in accordance with SCS methods for determining runoff using a curve number of 91 and antecedent moisture condition III. The Soil Series in this watershed were Haig, Sampsel, and Deepwater (4). The hydrologic soil groups in the basin were C, D, and C respectively.

e. The 100-year frequency inflow hydrograph was developed using a curve number of 79 and antecedent moisture condition II. The 100-year, 24 hour rainfall totaling 7.7 inches was provided by the Corps of Engineers, St. Louis District.

2. Drop inlet spillway release rates are based on broad-crested weir equation.

$Q = CLH^{1.5}$ (C = 2.7, L = length of the spillway crest in feet = 46 to 58 feet, and H is the head on the weir in feet.)

Spillway releases were controlled by the 7 foot by 12 foot concrete arch culvert above elevation 870.0 assuming outlet control.

$$H = \left[\frac{1.555\ (1+K_e)}{D^4} + \frac{287.64 n^2 L}{D^{5.3}} \right] \left(\frac{Q}{10} \right)^2$$

(H = head in feet, K_e = entrance loss coefficient = 0.7 D = height, also span of box in feet, n = Manning's roughness coefficient = 0.012, L = length of culvert in feet = 46 feet, and Q = discharge rate in cubic feet per second (cfs))(5).

Discharge rates over the top of the dam are also based on the broad-crested weir equation for weirs level and not level.

Broad crested weir equation for level weirs:

$Q = CLH^{1.5}$ (C = 2.6, L = length of weir section in feet, and H is the head on the weir in feet.)

Broad crested weir equation for weirs not level:

$$Q = \frac{2\ C\ b}{5(h_b - h_a)} (h_b^{2.5} - h_a^{2.5})$$

(C = 2.6, b = length of flow normal to weir in feet, h_a is the head on the high end of the weir in feet, and h_b is the head on the low end of the weir)(6).

3. The elevation-storage relationship above normal pool elevation was constructed by planimetering the area enclosed within each contour above normal pool. The storage between two elevations was computed by multiplying the average of the areas at the two elevations by the elevation difference. The summation of these increments below a given elevation is the storage below that level.

4. Floods are routed through the spillway using HEC-1, modified Puls to determine the capability of the spillway.

(1) U.S. Department of Agriculture, Soil Conservation Service, National Engineering Handbook, Section 4, Hydrology, August 1972.

(2) U.S. Army Corps of Engineers, Hydrologic Engineering Center, Flood Hydrograph Package (HEC-1), Dam Safety Version, July 1978, Davis, California.

(3) U.S. Department of the Interior, Bureau of Reclamation, Design of Small Dams, 1974, Washington, D.C.

(4) U.S. Department of Agriculture, Soil Conservation Service, draft report on Johnson County Soil and Water Conservation District Missouri.

(5) Department of the Army Technical Manual, Drainage and Erosion Control, Drainage for Areas Other than Airfields, TM 5-8204, July 1965.

(6) U.S. Department of the Interior, Geological Survey, Techniques of Water-Resources Investigations, Book 3, Chapter A5, Measurement of Peak Discharge at Dams by Indirect Methods, by Harry Hulsing, 1967.

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**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  26 FEB 79
**********************************
A1***** ROCK ISLAND LAKE DAM I.D.#20182  - MISSOURI DAM INSPECTION STUDY *****
A2ROUTING COMPUTATION FOR ROCK ISLAND LAKE RESERVOIR
A3DRAINAGE AREA = 336 ACRES = 0.525 SQ.MI.
B    288       0       5       0       0       0       0       0       0       0
B1     5
J      1       9       1
J1    .5     .55      .6     .65      .7     .75      .8     .85      1.
K      0       1                               3       1
K1 ROCK ISLAND LAKE DAM          (24HR. PROBABLE MAXIMUM RUNOFF)
M      1       2  0.525                        1
P           25.0     101     120     130
T                                                     -1     -91
W2          0.31
X                      1
K      1       2                                       1
K1 ROUTINE THROUGH ROCK ISLAND LAKE RESERVOIR
Y                                      1       1
Y1     1                                              -1      -1
Y4866.0 866.5   867.0   867.5   868.0   868.5   869.0   869.5   870.0   870.5
Y4871.0 871.5   872.0   872.5
Y5 0.   46.     130.    238.    370.    531.    716.    920.    980.    1177.
Y52132. 4242.   7675.   12722.
$S 0.   180.3   1180.8
$E866.0 870.    880.
$$ 866.0
$D 870.1      0.     1.5      0.
K     99
```

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

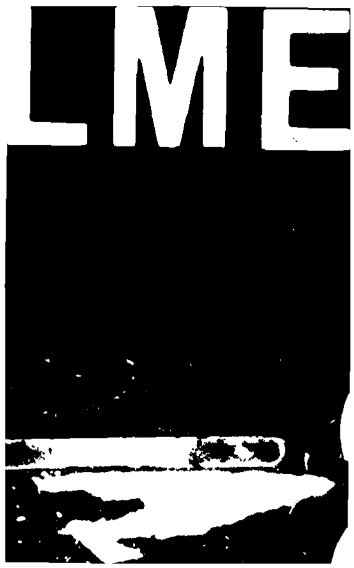
				RATIOS APPLIED TO FLOWS								
OPERATION	STATION	AREA	PLAN	RATIO 1 .50	RATIO 2 .55	RATIO 3 .60	RATIO 4 .65	RATIO 5 .70	RATIO 6 .75	RATIO 7 .80	RATIO 8 .85	RATIO 9 1.00
HYDROGRAPH AT	1	.53	1	2373.	2610.	2847.	3085.	3322.	3559.	3796.	4034.	4746.
	(	1.36)	(	67.19)(	73.91)(	80.63)(	87.35)(	94.07)(	100.78)(	107.50)(	114.22)(	134.38)
ROUTED TO	2	.53	1	941.	983.	1045.	1106.	1167.	1379.	1592.	1793.	2562.
	(	1.36)	(	26.66)(	27.83)(	29.59)(	31.32)(	33.05)(	39.06)(	45.08)(	50.78)(	72.55)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	866.00	866.00	870.10
STORAGE	0.	0.	197.
OUTFLOW	0.	0.	1019.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	869.68	0.00	172.	941.	0.00	16.42	0.00
.55	870.01	0.30	187.	983.	0.00	16.42	0.00
.60	870.16	.06	203.	1045.	.75	16.42	0.00
.65	870.32	.22	219.	1106.	1.50	16.42	0.00
.70	870.48	.38	234.	1167.	2.08	16.50	0.00
.75	870.60	.50	247.	1379.	2.42	16.42	0.00
.80	870.71	.61	258.	1592.	2.67	16.33	0.00
.85	870.82	.72	268.	1793.	2.75	16.33	0.00
1.00	871.10	1.00	296.	2562.	3.17	16.25	0.00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